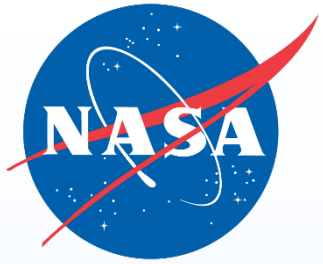


NASA EEE Parts and NASA Electronic Parts and Packaging (NEPP) Program – Welcome to the Ninth Annual Electronics Technology Workshop (ETW)

Kenneth A. LaBel

NEPP Program Manager

ken.label@nasa.gov

Acknowledgment:

This work was sponsored by: NASA Office of Safety & Mission Assurance

Acronyms

- Three Dimensional (3D)
- The Aerospace Corporation (Aerospace)
- Air Force (AF)
- Air Force Research Laboratory
- Amkor Technology
- Ames Research Center (ARC)
- Arctic Slope Regional Corporation (ASRC) Federal Space and Defense (AS&D)
- Bayesian Networks (BN)
- Body of Knowledge (BOK)
- Capability Leadership Teams (CLTs)
- Complementary Metal Oxide Semiconductor (CMOS)
- Carnegie Mellon University (CMU)
- Commercial Off-the-Shelf (COTS)
- Cosmic Ray Effects on Micro-Electronics (CRÈME)
- Defense Logistics Agency (DLA)
- Department of Defense (DoD)
- Department of Energy (DOE)
- Electrical, Electronic, and Electromechanical (EEE)
- NEPP Electronics Technology Workshop (ETW)
- Field Programmable Gate Array (FPGAs)
- MSU Facility for Rare Isotope Beams (FRIB)
- Gallium Nitride (GaN)
- Government-Industry Data Exchange Program (GIDEP)
- Glenn Research Center (GRC)
- Goddard Space Flight Center (GSFC)
- Goal Structuring Notation (GSN)
- Headquarters (HQ)
- Integra Technologies, LLC (Integra)
- Joint Electron Device Engineering Council (JEDEC)
- Jet Propulsion Laboratories (JPL)
- Johnson Space Center (JSC)
- Langley Research Center (LaRC)
- Lawrence Berkeley National Laboratories (LBNL)
- Mission Assurance Improvement Workshop (MAIW)
- Model-Based Mission Assurance (MBMA)
- Missile Defense Agency (MDA)
- Michigan State University (Michigan)
- Marshall Space Flight Center (MSFC)
- Michigan State University (MSU)
- National Aeronautics and Space Administration (NASA)
- NASA Electronic Parts Assurance Group (NEPAG)
- NASA Electronic Parts and Packaging (NEPP) Program
- NASA Engineering and Safety Center (NESC)
- United States Navy National Reconnaissance Office (NRO)
- National Superconducting Cyclotron Laboratory (NSCL)
- NASA Space Radiation Laboratory (NSRL)
- NASA Office of the Chief Engineer (OCE)
- NASA Office of Safety and Mission Assurance (OSMA)
- Point of Contact (POC)
- Reliability and Maintainability (R&M)
- Vanderbilt University's Notional RHA Tool (R-GENTIC)
- Radiation Hardened (RH)
- Radiation Hardness Assurance (RHA)
- Society of Automotive Engineers (SAE)
- Space Asset Protection Program (SAPP)
- Systems Engineering and Assurance Modeling (SEAM)
- Single Event Effect (SEE)
- Single Event Upset (SEU)
- Silicon Carbide (SiC)
- Air Force Space and Missile Systems Center (SMC)
- Subject Matter Expert (SME)
- SSL is a business unit of Maxar Technologies (SSL)
- NASA Space Technology Mission Directorate (STMD)
- SUNY Polytechnic Institute (SUNY)
- University of Surrey (Surrey)
- System Modeling Language (SysML)
- Texas A&M University (TAMU)
- To Be Determined (TBD)
- Texas Instruments (TI)
- Technical Operating Reports (TORs)

Outline

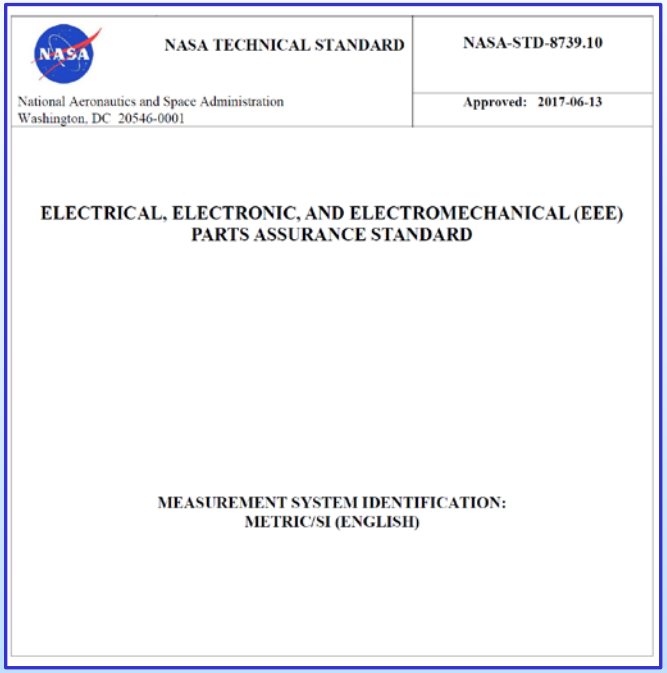
- Meeting Introduction and Logistics
- NEPP Program
  - Brief Diatribe: NASA Electrical, Electronic, and Electromechanical (EEE) Structure
  - NEPP Program Structure
- NEPP 2018
  - NEPP Overview
  - Changes in 2018
  - Key efforts, concerns, and status
- NASA Electronics Parts Assurance Group (NEPAG)
- Summary

Ninth Annual ETW!

- **Annual meeting**
  - **Originally, "just" a Program Review**
  - **Has morphed intro a Program Review with multiple focused and timely technical and infrastructure topics**
    - **Examples include: Space Radiation Test Facilities, Copper Bond Wires, 2.5/3D Packaging, Small Mission Success, and more!**
- **Four full days**
  - **All presentations will be posted on the NEPP website after appropriate release by presenters and their organizations**
- **Long breaks and on-your-own lunch periods to foster networking opportunities**
- **Coffee is supplied by hosts (but Starbucks across the street)**
- ***>350 registrants this year***

NASA EEE Parts – New Structure

- **New NASA EEE Parts Manager:**
  - **Leads efforts related to EEE Parts workforce and capabilities**
  - **Jonathan Pellish is the new EEE Parts Manager***
- **NEPP remains *virtually* the same:**
  - **Owns the EEE parts assurance processes (and related technical efforts)**
- **Increased NASA-wide documents**
  - **NASA Standard 8739.10, *Released***
  - **EEE-INST-002 update and unification underway***



NASA TECHNICAL STANDARD

NASA-STD-8739.10

National Aeronautics and Space Administration
Washington, DC 20546-0001

Approved: 2017-06-13

ELECTRICAL, ELECTRONIC, AND ELECTROMECHANICAL (EEE) PARTS ASSURANCE STANDARD

MEASUREMENT SYSTEM IDENTIFICATION: METRIC/SI (ENGLISH)

*** = on the agenda**

General NASA EEE Parts Interfaces

Agency EEE Parts

Assurance	Development		Facilities
Office of Safety & Mission Assurance	Office of the Chief Engineer	Flight Projects	Mission Support
NEPP Workmanship Quality Model Based Mission Assurance (MBMA) Reliability and Maintainability (R&M)	Capability Leadership NESC	Field Centers Mission Directorates	Space Environments Testing Management

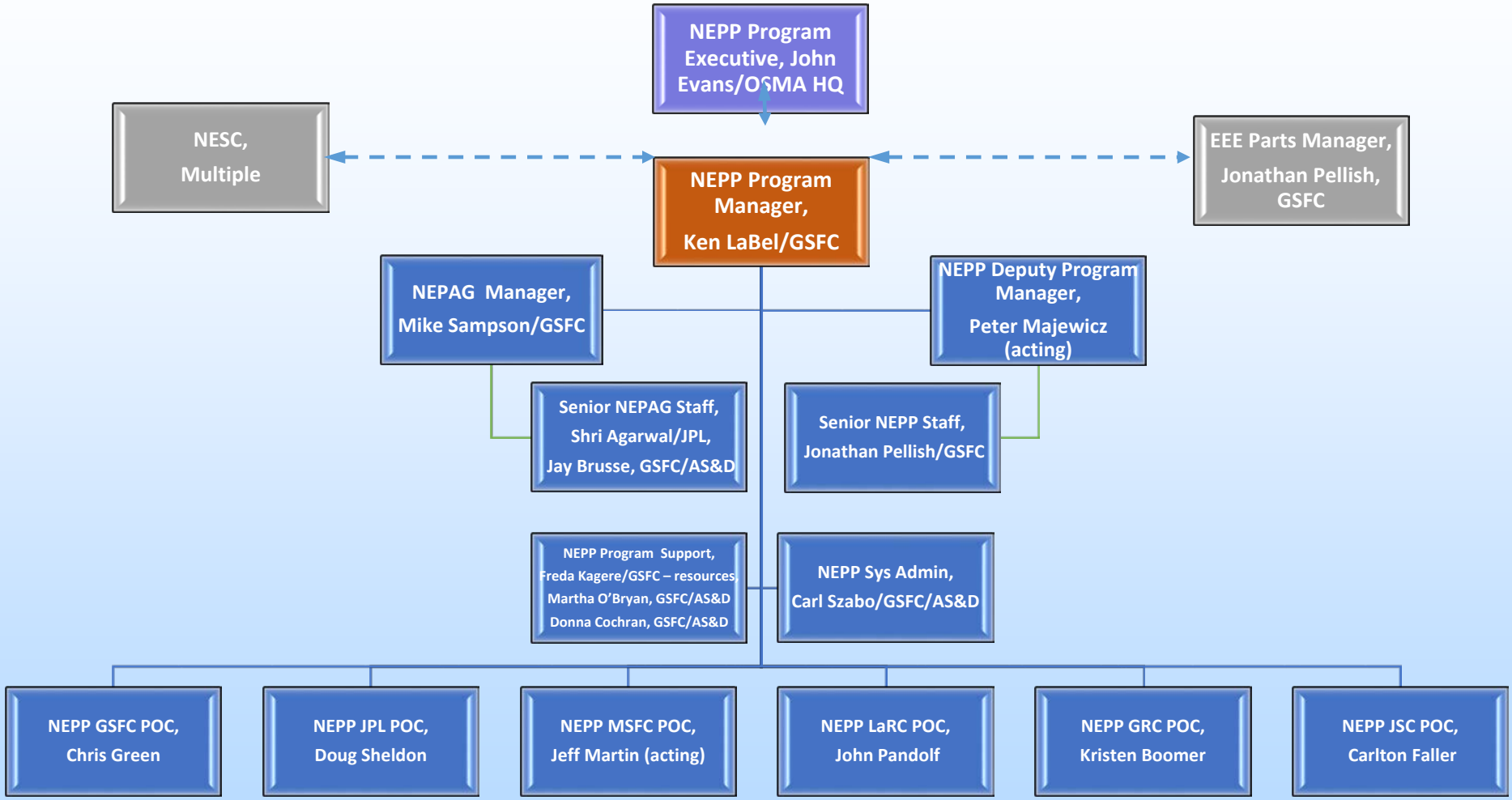
NEPP Mission Statement

Provide NASA's leadership for developing and maintaining guidance for the screening, qualification, test, and reliable use of Electrical, Electronic, and Electromechanical (EEE) parts by NASA, in collaboration with other government agencies and industry.

Note: The NASA Electronic Parts Assurance Group (NEPAG) is a key portion of NEPP

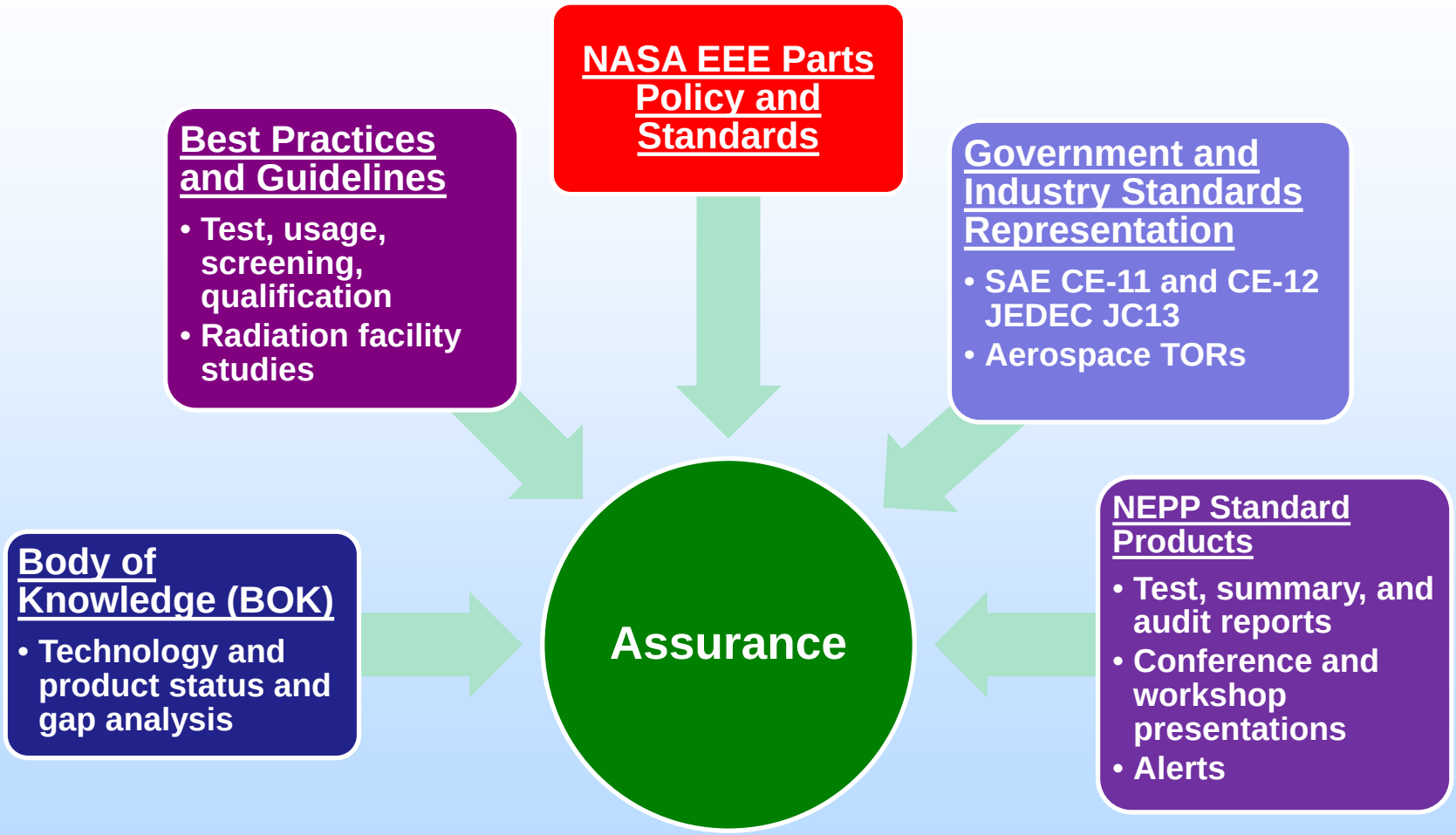
- Standards, working groups, guidance, problem parts, …

NEPP Program – Organization Chart



NEPP - Charter

NEPP – Product Delivery



Related task areas:

Technology/parts evaluations lead to new best practices, guidelines,…

What's New for NEPP?

- Agency EEE Parts Manager
  - Support efforts on workforce, facilities, etc…
- Increased delivery of assurance products
  - BOKs, Guidelines, Tools, Information Sharing, Training
  - Unification of NASA documentation (NEPAG)
- Increased discussion on the role of standardization processes (NEPAG) and data sharing
- Increased emphasis on
  - Guidance and understanding of small missions such as CubeSats
  - Model-based mission assurance (MBMA) and radiation tool "standardization"
  - Changing EEE parts industry such as the move to "mid-space"
  - Partnering with other NASA organizations, Agencies, and universities
    - Expansion of outreach in all these areas
- Significant update of the NEPP website planned
  - Easier to find guidance and search for data
  - New tie-ins to the SmallSat community
- First look at "big data" analyses…

Providing Guidance Based on Function and Exposure since 2014

Criticality	Low	Medium	High
High	Level 1 or 2 suggested. COTS upscreening/ testing recommended. Fault tolerant designs for COTS.	Level 1 or 2, rad hard suggested. Full upscreening for COTS. Fault tolerant designs for COTS.	Level 1 or 2, rad hard recommended. Full upscreening for COTS. Fault tolerant designs for COTS.
Medium	COTS upscreening/ testing recommended. Fault-tolerance suggested	COTS upscreening/ testing recommended. Fault-tolerance recommended	Level 1 or 2, rad hard suggested. Full upscreening for COTS. Fault tolerant designs for COTS.
Low	COTS upscreening/ testing optional. Do no harm (to others)	COTS upscreening/ testing recommended. Fault-tolerance suggested. Do no harm (to others)	Rad hard suggested. COTS upscreening/ testing recommended. Fault tolerance recommended

Environment/Lifetime

The Future of Radiation Hardness Assurance (RHA)?

Bottom line goal:

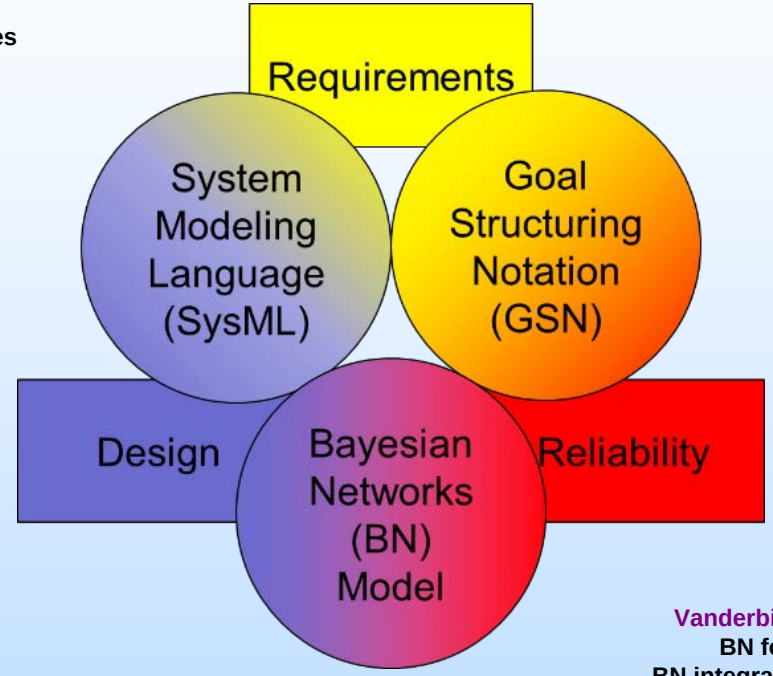
Provide appropriate and stream-lined approaches for flight projects (of all sizes)

NEPP Small Mission Efforts and MBMA (w/ NASA MBMA Program)

NASA/GSFC (Campola)
Small Mission RHA
TBD
Small Mission EEE Parts Best Practices

NASA/GSFC (Xapsos)
RHA Confidence Approach

Air Force SMC
CubeSat Supply Chain and "Mid-space" Grade Electronics Survey and Requirements Definition



Saint Louis University
CubeSat Success Study

JPL
CubeSat EEE Parts Databases

TBD
CubeSat EEE Parts Testing

TBD
Resilience, autonomy

Vanderbilt University
GSN Exemplar (SEE) – complete
TBD
GSN Exemplar – EEE parts reliability

NASA/GSFC (Berg)
SEE Classic Reliability

Vanderbilt
CRÈME Toolsuite

Vanderbilt University
BN follow-on
BN integrated into SEAM

Other
Integration with Small Spacecraft Virtual Institute (NASA/ARC)
https://www.nasa.gov/smallsat-institute

Emerging Modeling
Vanderbilt University
Web-based tool (SEAM)
NASA/GSFC (Campola) - Vanderbilt
Notional RHA Tool (R-GENTIC)

Other
MAIW
SmallSat Reliability Initiative (NASA/AF/ others)

https://modelbasedassurance.org/

***Tenet:** the best ideas will die on the vine without integration into standard approaches or tools. It's all about access.*

Notional Schedule

Mon	18-Jun	Tues	19-Jun	Wed	20-Jun	Thurs	21-Jun
NEPP Overview	LaBel - NASA NEPP	Radiation Test Facilities	National Academies of Science Outbrief of Testing at the Speed of Light - Nielsen - CMU (study co-lead), et al	Processors	Guertin - NASA JPL, Wyrwas - NASA-GSFC/Lentech	Small Spacecraft Systems Virtual Institute (S3VI)	Yost - NASA ARC
NASA Parts Standard and Plans Moving Forward	Majewicz - NASA NEPP		Clark - TAMU, Phair - LBNL, Sivertz - NSRL, MSU, Stolz - NSCL/FRIB, LaBel - NASA NEPP (brief proton status)	Memories	Wilcox - NASA GSFC, Wyrwas - NASA GSFC/Lentech	Small Mission Success	Organized by Swartwout - SLU (LaBel - NASA NEPP subbing in person)
NASA EEE Parts Manager Overview	Pellish - NASA		Future path brainstorming	FPGAs	Berg - NASA GSFC/AS&D, Allen - NASA JPL		James Cutler (Michigan) Chris Bridges (Surrey) David Hinkley (Aerospace) Chris Mattmann (JPL) Bob Bruninga (US Naval Academy) Lee Jasper (Space Dynamics Laboratory & AFRL) TBD
EEE-INST Unification and Update	Majewicz - NASA NEPP, Siddiqi -NASA/GSFC - AS&D			SiC and GaN (Power)	Lauenstein - NASA GSFC, Scheick - NASA JPL	NEPP Small Mission Guidance	Campola, Green, Moe - NASA GSFC
Government Working Group and Hybrids Working Group	Laird - NASA MSFC, Majewicz - NASA NEPP	Advanced device packaging (2.5/3D, etc…)	Lead: Sheldon, NASA JPL (presentation)	GaN RF Qualification	Scarpulla - Aerospace	Board Level Testing	Dodd - DFR Solutions
PEMS/PEDS/Cu	Sampson - NASA NEPP, Lilani - Integra, Saran - TI, Jarvis - Army, Varner - MDA, Pedigo - Navy Crane		Lloyd - SUNY, Rose - Polaris Alpha, Popelar - Cobham, Suh/Reideau - NASA JPL, Ghaffarian - NASA JPL, Alles - Vanderbilt, TBD - GF, Silvestri - Amkor	Capacitors, Resistors	Hong-Aerospace (MIL-PRF vs AECQXXX), Teverosvky - NASA/GSFC - AS&D, Shue - NASA/GSFC	COTS Data Sharing	Yarbrough - Aerospace
				ESD Surveys and Gaps	Agarwal - NASA JPL	Big Data (radiation)	Allen - NASA JPL
				COTS diodes in Hi-rel applications	Loman - SSL	Model Based Mission Assurance	Austin - Vanderbilt/NASA GSFC
				Panel: Utility of EEE Parts Audits	Lead: Sampson, NASA NEPP; Harzstark, Panning - Aerospace; Majewicz - NASA NEPP, Agarwal - NASA JPL, TBD	Integration of tools	Witulski or Sierawski - Vanderbilt

Questions?

https://nepp.nasa.gov